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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/693,619	10/24/2003	Erlend Ronnekleiv	WEAT/0349	1501

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EXAMINER	
DETSCHEL, MARISSA	
ART UNIT	**PAPER NUMBER**
2877	

DATE MAILED: 10/06/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	10/693,619	RONNEKLEIV, ERLEND
	Examiner	**Art Unit**
	Marissa J. Detschel	2877

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 31 July 2006.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1 and 3-32 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1,3,5-7,10-12,15,20,22-24 and 27-30 is/are rejected.

7)☒ Claim(s) 4,8,9,13,14,16-19,21,25,26,31 and 32 is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 23 October 2004 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date 4/28/06.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on July 31, 2006, has been entered.

Information Disclosure Statement

The information disclosure statement filed on April 28, 2006, has been fully considered by the Examiner.

Claim Objections

Claim 28 is objected to because of the following informalities: The word “co-located” is still present in line 3 of this claim. Based on the amendment in claim 27, the Examiner suggests changing this to “located in close proximity such that the sensor interferometer and the reference interferometer are exposed to substantially equal environmental conditions”.

Appropriate correction is required.

Claim Rejections - 35 USC § 101

35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

Claims 1, 10, and 15 are rejected under 35 U.S.C. 101 because the claimed invention is directed towards non-statutory subject matter.

As to claim 1, the claim appears to be useful and concrete, but there is no tangible result claimed. The claimed result of merely "generating a corrected sensor frequency parameter..." would not appear to be sufficient to constitute a tangible result, since the outcome of the "generating a corrected sensor frequency parameter..." step has not been used in a disclosed practical application nor made available in such a manner that its usefulness in a disclosed practical application can be realized. See OG Notices: 22 November 2005, "Interim Guidelines for Examination of Patent Applications for Patent Subject Matter Eligibility".

As to claim 10, the claim appears to be useful and concrete, but there is no tangible result claimed. The claimed result of merely "generating a corrected sensor phase..." would not appear to be sufficient to constitute a tangible result, since the outcome of the "generating a corrected sensor phase..." step has not been used in a disclosed practical application nor made available in such a manner that its usefulness in a disclosed practical application can be realized. See OG Notices: 22 November 2005, "Interim Guidelines for Examination of Patent Applications for Patent Subject Matter Eligibility".

As to claim 15, the claim appears to be useful and concrete, but there is no tangible result claimed. The claimed result of merely "correcting the sensor signal for errors..." would not appear to be sufficient to constitute a tangible result, since the outcome of the "correcting the sensor signal for errors..." step has not been used in a

disclosed practical application nor made available in such a manner that its usefulness in a disclosed practical application can be realized. See OG Notices: 22 November 2005, "Interim Guidelines for Examination of Patent Applications for Patent Subject Matter Eligibility".

More specifically, Part b. *Practical Application the Produces a Useful, Concrete, and Tangible Result* under Section IV *Determine Whether the Claimed Invention Complies with the Subject Matter Eligibility Requirement of 35 U.S.C. Sec. 101* sentence 3 in the OG Notice from 22 November 2005 states 'In determining whether the claim is for a "practical application," the focus is <u>not on whether the steps taken to achieve a particular result</u> are useful, tangible, and concrete, but rather that the <u>final result</u> achieved by the claimed invention is "useful, tangible, and concrete."'

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1, 3, 10-12, 20, 23, and 24 are rejected under 35 U.S.C. 102(b) as being anticipated by McBride et al. (USPN 5,721,615).

Regarding claim 1, McBride discloses a method for sensing comprising:

interrogating at least one optical sensor;

Light from the sources is directed towards to sensing arm and into both mirrors of a sensor in the form of a sensing interferometer. As the light propagates through the mirrors, strain and temperature changes in the fiber cause changes in group delay and optical dispersion of the light. (column 11, lines 52-63) These changes result from an interrogation of the sensor by the strain and temperature changes.

interrogating at least one optical reference device located in close proximity with the optical sensor such that the optical sensor and the reference device are exposed to substantially equal environmental conditions;

After the interrogation of the sensor, the light is sent back into an optical reference device in the form of a reference interferometer. (column 11, line 63 to column 12, line 6) The sensor and reference devices are connected to each other because the light is sent from the sensor directly to the reference device. This means the sensors are in close proximity to each other. Also, the sensor and reference device can be located inside in an aircraft airframe interior. (column 12, lines 26-27) Therefore, they are located in the same environment in the form of the aircraft airframe interior, and, thus, are exposed to substantially equal environmental conditions.

extracting a sensor optical frequency parameter from a signal received from the sensor;

extracting a reference optical frequency parameter from a signal received from the reference device; and

generating a corrected sensor optical frequency parameter based on the sensor and reference optical frequency parameters,

Interferograms of the signals coming from the reference device and sensor are generated at detectors. (column 12, lines 6-14) The influence of temperature and strain on the passage of light through the sensing interferometer is calculated using these interferograms. Two sets, R and S, are determined. S contains elements which directly influence the optical path length of the sensor. R contains elements that affect the optical path of both the sensor and reference device. An initial state of the interferometers is defined in terms of an initial strain and temperature state of the system. R and S are determined from this initial state as well. All of these measurements are expressed in terms of a phase difference, which depends on frequency. (column 8, line 59 to column 9, line 11) Therefore, a sensor and a reference optical frequency parameter are received from the sensor.

If the strain and temperature applied to the sensor change, then the phase difference relationship changes from the initial state. After a Fast Fourier Transform of the interferograms produce the phase difference values, a least squares polynomial fit is applied to the initial and measured states to produce four coefficients of phase for each

interferogram detected. The first and second order phase coefficients correspond to group delay and dispersion, and by comparing these values of the initial and measured state, values for the difference in temperature and strain between the two states are determined. (column 10, lines 6-16) This represents a generated corrected optical frequency parameter based on the sensor and reference optical frequency parameters.

wherein the optical sensor is sensitive to at least one measurand and the reference device is insensitive to the at least one measurand.

The reference device is in a thermally isolated enclosure (column 11, lines 5-6). Therefore, this device is not sensitive to temperature, whereas the sensor is sensitive.

Regarding claim 10, McBride's method uses interferometers as the sensor and reference device. The signals extracted from the sensors are in the form of phase difference values, and the phase coefficients of these phase values are used to determine the corrected sensor phase, as disclosed in reference to claim 1.

In regards to claim 20, McBride discloses a sensor system (figure below) comprising:

A light source (250 and 248) for generating interrogating light signals;

At least one optical sensor (202) optically coupled (via 206) with the light source wherein the at least one optical sensor is sensitive to at least one measurand;

Light from the sources is directed towards to sensing arm and into both mirrors of a sensor in the form of a sensing interferometer. As the light propagates through the mirrors, strain and temperature changes in the fiber cause changes in group delay and optical dispersion of the light. (column 11, lines 52-63) These changes result from an interrogation of the sensor by the strain and temperature changes.

At least one optical reference device (204) located in close proximity with the optical sensor such that the optical sensor and the reference device are exposed to substantially equal environmental conditions, and optically coupled (via 206) with the light source, wherein the at least one optical reference device is insensitive to the at least one measurand; and

After the interrogation of the sensor, the light is sent back into an optical reference device in the form of a reference interferometer. (column 11, line 63 to column 12, line 6) The sensor and reference devices are connected to each other because the light is sent from the sensor directly to the reference device. This means the sensors are in close proximity to each other. Also, the sensor and reference device can be located inside in an aircraft airframe interior. (column 12, lines 26-27) Therefore, they are located in the same environment in the form of the aircraft airframe interior, and, thus, are exposed to substantially equal environmental conditions. The reference device is in a thermally isolated enclosure (column 11, lines 5-6). Therefore, this device is not sensitive to temperature, whereas the sensor is sensitive.

control circuitry configured to interrogate the sensor with light from the light source to generate a sensor signal, interrogate the reference device with light from the light source to generate a reference signal, extract a sensor optical frequency parameter from the sensor signal, extract a reference optical frequency parameter from the reference signal, and generate a corrected sensor optical frequency parameter based on the sensor and reference optical frequency parameters.

Interferograms of the signals coming from the reference device and sensor are generated at detectors. (column 12, lines 6-14) The influence of temperature and strain on the passage of light through the sensing interferometer is calculated using these interferograms. Two sets, R and S, are determined. S contains elements which directly influence the optical path length of the sensor. R contains elements that affect the optical path of both the sensor and reference device. An initial state of the interferometers is defined in terms of an initial strain and temperature state of the system. R and S are determined from this initial state as well. All of these measurements are expressed in terms of a phase difference, which depends on frequency. (column 8, line 59 to column 9, line 11) Therefore, a sensor and a reference optical frequency parameter are received from the sensor.

If the strain and temperature applied to the sensor change, then the phase difference relationship changes from the initial state. After a Fast Fourier Transform of the interferograms produce the phase difference values, a least squares polynomial fit is

applied to the initial and measured states to produce four coefficients of phase for each interferogram detected. The first and second order phase coefficients correspond to group delay and dispersion, and by comparing these values of the initial and measured state, values for the difference in temperature and strain between the two states are determined. (column 10, lines 6-16) This represents a generated corrected optical frequency parameter based on the sensor and reference optical frequency parameters.

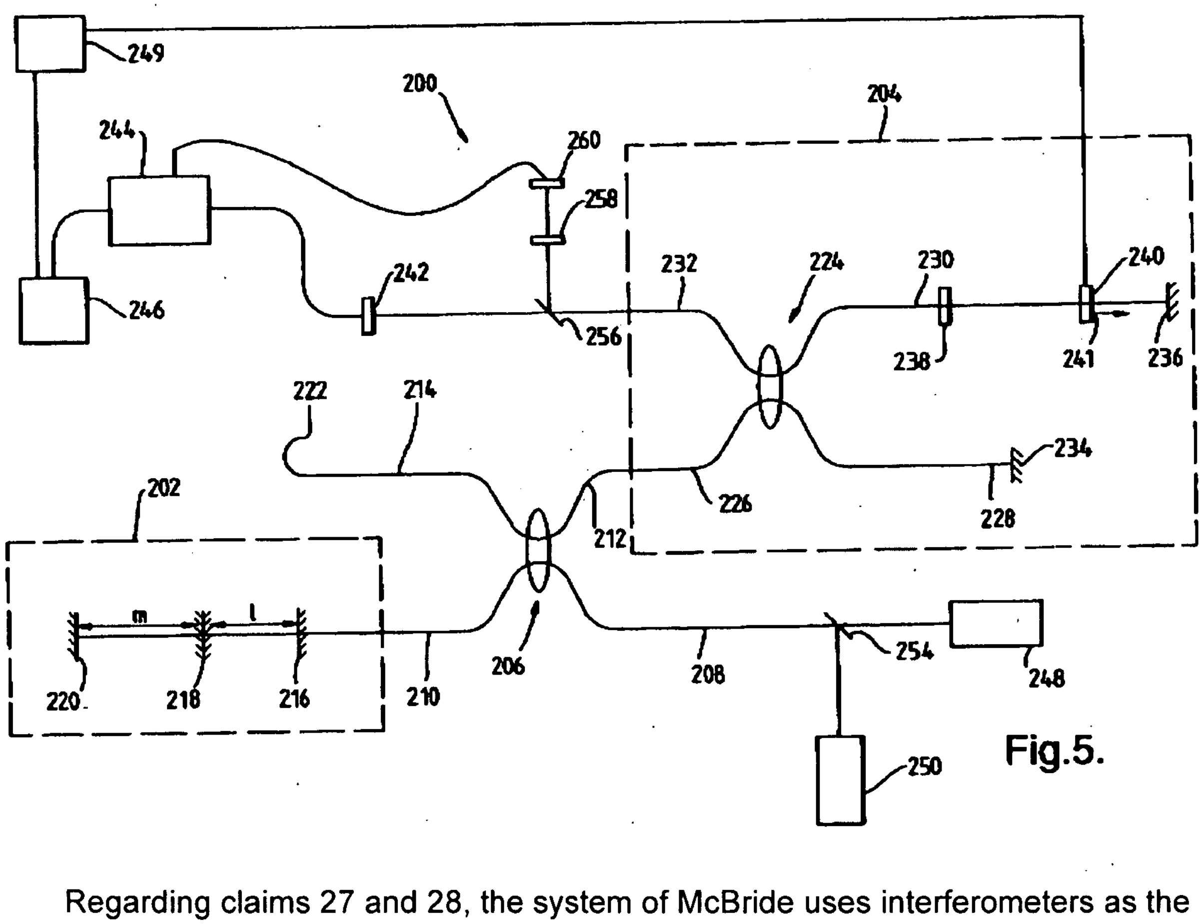

Fig.5.

Regarding claims 27 and 28, the system of McBride uses interferometers as the reference device and sensor, as disclosed in reference to claim 20 above. Also, McBride discloses that the system can be used for making a number of simultaneous

measurements at different locations in an environment (column 12, lines 24-26). An example of an environment such as this is down a wellbore, to take measurements of downhole parameters such as temperature and strain.

In regards to claims 11, 23, and 29 McBride's reference and sensor share a common lead waveguide, as illustrated in the figure above.

Regarding claims 3, 12, and 24, McBride discloses that the reference optical frequency parameter is scaled using Taylor coefficients and the corrected sensor optical frequency parameter is found by subtracting the Taylor coefficients of the initial state from the measured state, resulting in the corrected sensor optical frequency parameter (column 10, lines 62-67).

Claims 1, 5-7, 20, 22, and 23 are rejected under 35 U.S.C. 102(e) as being anticipated by Siems et al. (USPN 6,522,797).

Regarding claim 1, Siems discloses a method for sensing comprising:

interrogating at least one optical sensor;

Light from a light source reflects off each mirror from the sensing device. (column 9, lines 31-33)

interrogating at least one optical reference device located in close proximity with the optical sensor such that the optical sensor and the reference device are exposed to substantially equal environmental conditions;

Light from a light source reflects off each mirror from the reference device. (column 9, lines 30-31) The reference and sensor devices are exactly parallel to each other, and are therefore subjected to the same temperature, vibration, and accelerations effects. (column 9, lines 13-18) Therefore, both the reference device and sensor are exposed to substantially equal environments.

extracting a sensor optical frequency parameter from a signal received from the sensor;

extracting a reference optical frequency parameter from a signal received from the reference device; and

generating a corrected sensor optical frequency parameter based on the sensor and reference optical frequency parameters,

The two light beams reflected from the reference device and sensor are combined at a 2x2 WDM coupler and 50% of the combined light is sent to a compensating interferometer. The combined light signal is sent along a delayed path and an undelayed path to a 3x3 optical coupler. At this coupler, the delayed pulse of each signal, represented by the wavelength of the combined light signal, will interfere independently with the undelayed pulse of each signal of the same wavelength to create two interference patterns. These interference patterns produced by the two wavelengths are subtracted in the photodiodes, resulting in a cancellation of common mode effects in

the reference device and sensor. (column 9, lines 30-50) The signals of the reference device and sensor are in terms of wavelength in the device of Siems, but it is well known that frequency signals and wavelength signals are directly correlated with one another, and, thus, these wavelength signals could be in terms of frequency signals. The cancellation of common mode effects disclosed represents a corrected optical frequency parameter that is based on both the sensor and reference optical frequency parameters. (column 9, lines 30-50)

wherein the optical sensor is sensitive to at least one measurand and the reference device is insensitive to the at least one measurand.

The reference device is in the form of a fiber encased in a stainless steel tube, making it desensitized to acoustic pressure. (column 9, lines 6-8)

In regards to claim 20, Siems discloses a sensor system (figure below) comprising:

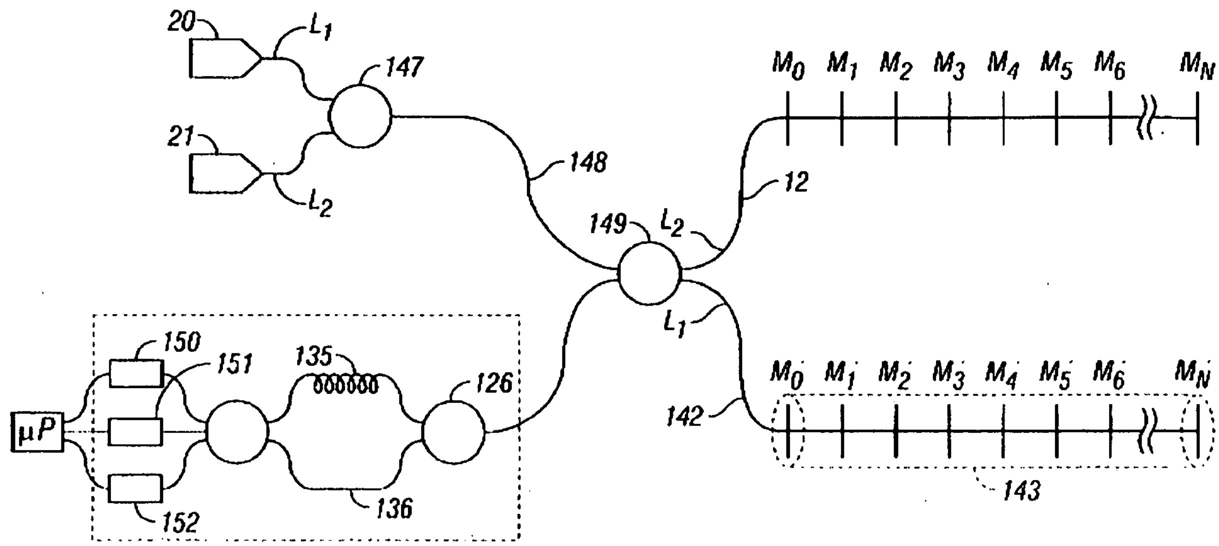

FIG. 5A

A light source (20, 21) for generating interrogating light signals;

At least one optical sensor (12 and top M_0-M_N) optically coupled (via 149) with the light source wherein the at least one optical sensor is insensitive to at least one measurand;

At least one optical reference device (142 and bottom M_0-M_N) located in close proximity with the optical sensor such that the optical sensor and the reference device are exposed to substantially equal environmental conditions, and optically coupled with the light source (via 149), wherein the at least one optical reference device is insensitive to the at least one measurand; and

The reference device is in the form of a fiber (142) encased in a stainless steel tube (143), making it desensitized to acoustic pressure. Also, the reference and sensor devices are exactly parallel to each other, and are therefore subjected to the same temperature, vibration, and accelerations effects. (column 9, lines 6-8 and 13-18) Therefore, both the reference device and sensor are exposed to substantially equal environments.

control circuitry configured to interrogate the sensor with light from the light source to generate a sensor signal, interrogate the reference device with light from the light source to generate a reference signal, extract a sensor optical frequency parameter from the sensor signal, extract a reference optical frequency parameter from the reference signal, and generate a corrected sensor optical frequency parameter based on the sensor and reference optical frequency parameters.

Light from 20 (L_1) reflects off the each mirror from the reference device. Light from 21 (L_2) reflects off each mirror from the sensing device. These two light beams are combined at a 2x2 WDM coupler (149) and 50% of the combined light is sent to a compensating interferometer. The combined light signal is sent along a delayed path (135) and an undelayed path (136) to a 3x3 optical coupler. At this coupler, the delayed pulse of each signal, represented by the wavelength of the combined light signal, will interfere independently with the undelayed pulse of each signal of the same wavelength to create two interference patterns. These interference patterns produced by the two

wavelengths are subtracted in the photodiodes (150, 151, 152), resulting in a cancellation of common mode effects in the reference device and sensor. (column 9, lines 30-50) The signals of the reference device and sensor are in terms of wavelength in the device of Siems, but it is well known that frequency signals and wavelength signals are directly correlated with one another, and, thus, these wavelength signals could be in terms of frequency signals. The cancellation of common mode effects disclosed represents a corrected optical frequency parameter that is based on both the sensor and reference optical frequency parameters.

In regards to claim 5, the reference device or sensor could be an optical waveguide Bragg grating in the device of Siems. The mirrors used in the device can be replaced with Bragg gratings. (column 10, lines 13-16)

Regarding claims 6 and 23, the sensor and reference device comprising Bragg gratings would be optically coupled to a common lead waveguide. If the Bragg gratings replace the mirrors in the method of claim 5 and the system of claim 20, they would share a common lead waveguide from the light source, since the mirrors share a common lead waveguide from the light source.

Regarding claims 7 and 22, it is well known that when Bragg gratings are interrogated by an outside force (i.e. temperature, vibration, acceleration) that the central frequency of the Bragg gratings changes.

Allowable Subject Matter

Claim 15 would be allowable if rewritten or amended to overcome the rejection(s) under 35 U.S.C. 101 set forth in this Office action.

Claims 4, 8, 13, 14, 16-19, 21, 25, 26, 31, and 32 are objected to as being dependent upon a base claim rejected under 35 U.S.C. 101, but would be allowable if the base claim was rewritten or amended to overcome the rejection under 35 U.S.C. 101.

The following is a statement of reasons for the indication of allowable subject matter:

As to claims 4 and 25, the prior art of record, taken alone or in combination, fails to disclose or render obvious a method or system of scaling a reference optical frequency parameter by multiplying the parameter by a factor based on the ratio of the light signal frequencies used to interrogate the reference and sensor devices, in combination with the rest of the limitations of said claims.

As to claims 8, 21, and 26, the prior art of record, taken alone or in combination, fails to disclose or render obvious the use of a sensor laser as a reference device in a method or system for sensing, in combination with the rest of the limitations of said claims.

As to claims 13 and 31, the prior art of record, taken alone or in combination, fails to disclose or render obvious a method of scaling a reference phase by multiplying the phase by a factor based on the ratio of the different light signal frequencies used to interrogate the reference and sensor devices, in combination with the rest of the limitations of claim 13.

As to claims 14 and 32, the prior art of record, taken alone or in combination, fails to disclose or render obvious a method of scaling a reference phase by multiplying the reference phase by a scale factor determined by a ratio of different interferometer imbalances, in combination with the rest of the limitations of claim 14.

As to claim 15, the prior art of record, taken alone or in combination, fails to disclose or render obvious the method of interrogating a reference device and optical sensor co-located with each other, and correcting the sensor signal for errors due to Doppler shifts based on the reference signal, in combination with the rest of the limitations of claim 15.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Marissa J. Detschel whose telephone number is 571-272-2716. The examiner can normally be reached on M-F 8:30am-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Gregory J. Toatley, Jr. can be reached on 571-272-2059. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

MJD
September 29, 2006

Gregory J. Toatley, Jr.
Supervisory Patent Examiner